BACK ANALYSIS OF EXISTING SLOPES & ASSESSMENT OF CHARACTERISTIC VALUES FOR DINAHS HOLLOW

Literature Review

An initial Literature Review was undertaken prior to the analysis of *in situ* and laboratory test results from the 2014 site investigation. The intent of this was to establish a description of the natural geology as well as guideline ranges that the derived parameters would be reasonably expected to fall within based upon historical evidence.

The following sources were consulted with regards to this:

- British Geological Survey 1:10,000 Series, Sheet ST82SE (Shaftesbury)
- British Geological Survey, Geology of the country around Shaftesbury, Memoir for 1:50,000 geological sheet 313 (England and Wales), 1995
- Brunsden D, Landslides of the Dorset Coast, 1996
- Graham Daws Associates, Stability of Cliffs Adjacent to Cliff Path Lake Isle of Wight (Appendix 2)
- BS 6031:11981, Code of Practice for Earthworks
- Internal information relating to Charmouth Bypass

The results of the literature review indicate that the geology of the site area comprises the Upper Greensand formation, typically described as weakly cemented sandstone interbedded with layers of stronger sandstone, sand and chert.

The effective internal angle of friction of the Upper Greensand is anticipated to be within the range of 30° to 40°, typically 33° to 37°.

The effective cohesion of the Upper Greensand is anticipated to be within the range of 0kPa to 23kPa, typically 0kPa.

It should be noted that cohesion values of above 0kPa are only encountered in layers noted to be clay rich, and the granular qualities of the Upper Greensand are not typically associated with any significant amount of cohesion.

Back Analysis

A back analysis of the cutting slopes has been undertaken with the intent of establishing the minimum geotechnical parameters required to provide a Factor of Safety (FoS) greater than or equal to 1, thereby ensuring stability of the cutting slopes according to current standards.

The topographical survey provided by Merret Survey Ltd was utilised to produce the back analysis, and the approximate midpoint of the west cutting slope was selected as the most onerous section due to the increased height and overly steepened toe in that location. The effective internal angle of friction has been varied by increasing increments of 1.0° while remaining within the typical range specified by the literature review. The corresponding effective cohesion required to produce a FoS greater than 1 has then been calculated.

The results of the back analysis are presented on Table 1 below.

Table 1 – Minimum Geotechnical Parameters providing Stability

Effective Internal Angle of Friction (φ')	35°	36°	37°
Effective Cohesion (c')	10kPa	7.5kPa	7.5kPa

Notably, the results of the back analysis indicate that a significant level of effective cohesion is required to maintain stability.

It is considered unlikely that the granular nature of the natural ground would be capable of reaching such a significant level of cohesion. In the event some cohesion has been established with cementation of the granular material, this strength can be easily lost with any disturbance of the ground as was observed during initial site walkovers. It is therefore assumed that any effective cohesion of the ground cannot be relied upon in the long term life of the site

Assessment of Effective Stress & Internal Angle of Friction

General

When evaluating the data sets for the east and west slopes both separately and combined, it was concluded that the differences observed were sufficiently negligible to have minimal practical impact when undertaking the design. It was therefore decided that a single set of characteristic parameters would be sufficient to model both slopes.

Standard Penetration Test (SPT) Results

The results of the SPTs taken in the 2014 site investigation have been collated and assessed along with the results of the 2013 ground investigation by Brody Forbes, and relevant results from a 1981 investigation by Norwest Holst. These are as presented in Figure 1 below.

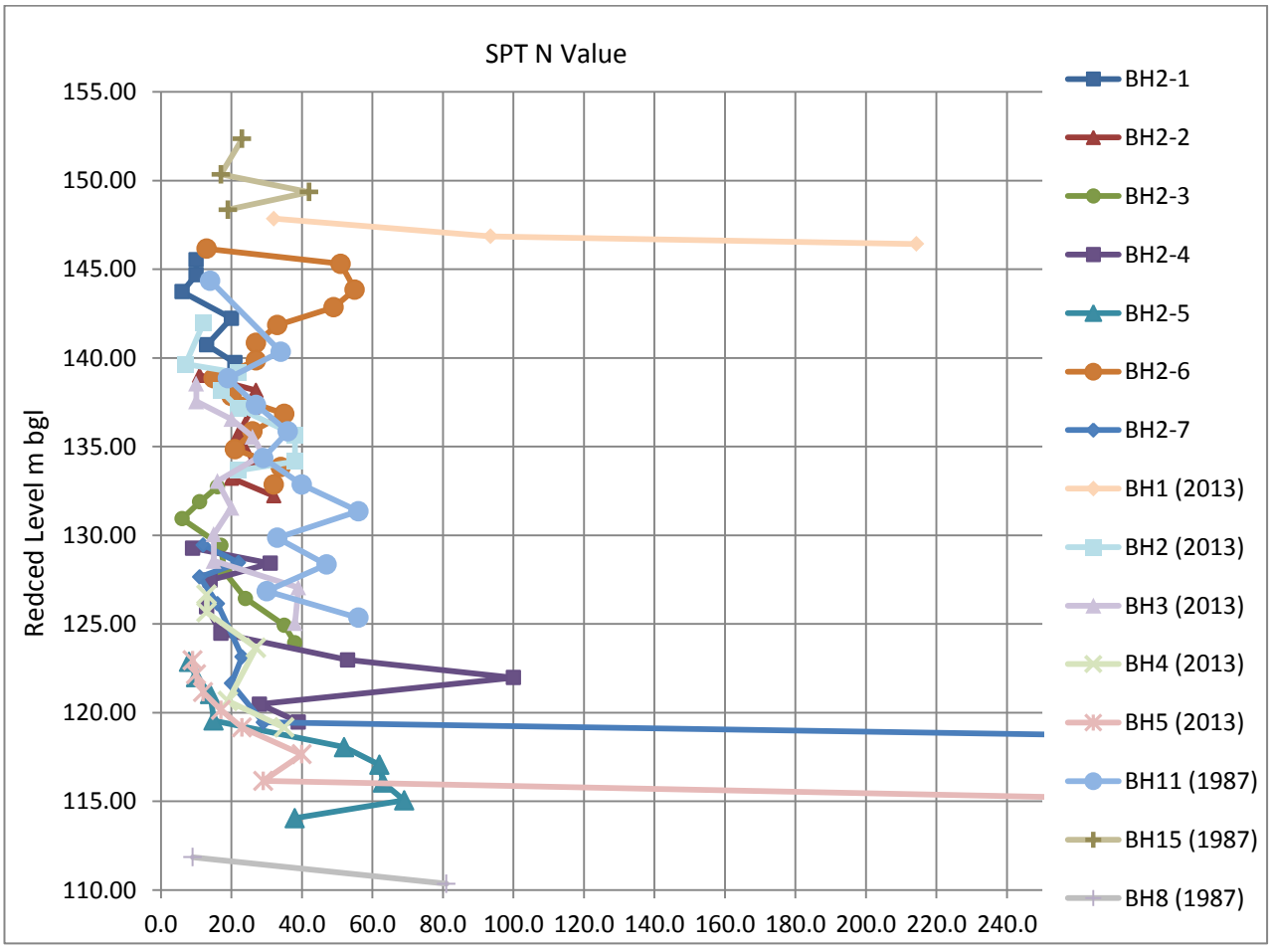

Figure 1 - SPT 'N' Value vs Reduced Level AoD

The effective internal angle of friction has been derived from each SPT result in accordance with BS8002, Table 2. These have been collated and presented in Figure 2 below.

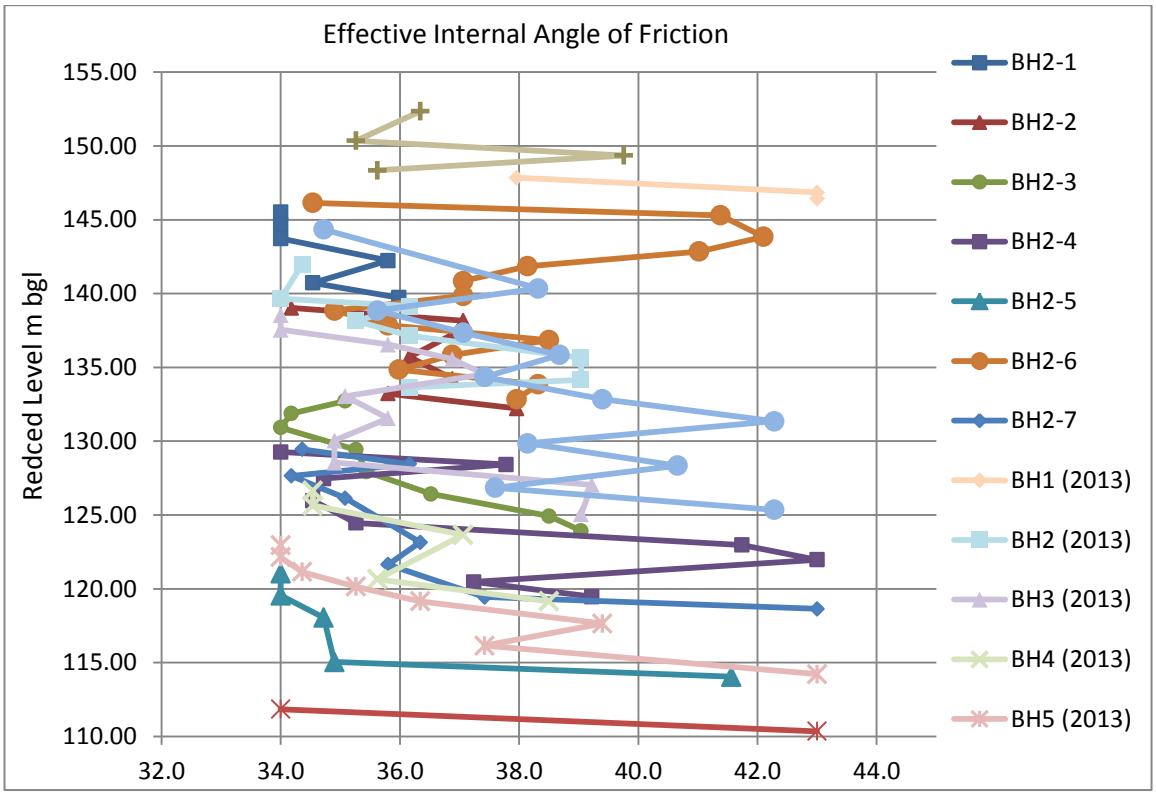

Figure 2 - Effective Internal Angle of Friction derived from SPT Results

Effective Stress Tests

Consolidated, drained Triaxial Tests have been undertaken as part of the 2014 site investigation, which provide an effective angle of shearing resistance. Assuming cohesion of 0kPa, the effective internal of friction has been derived from each Triaxial test. These results have been collated and presented in Figure 3 below.

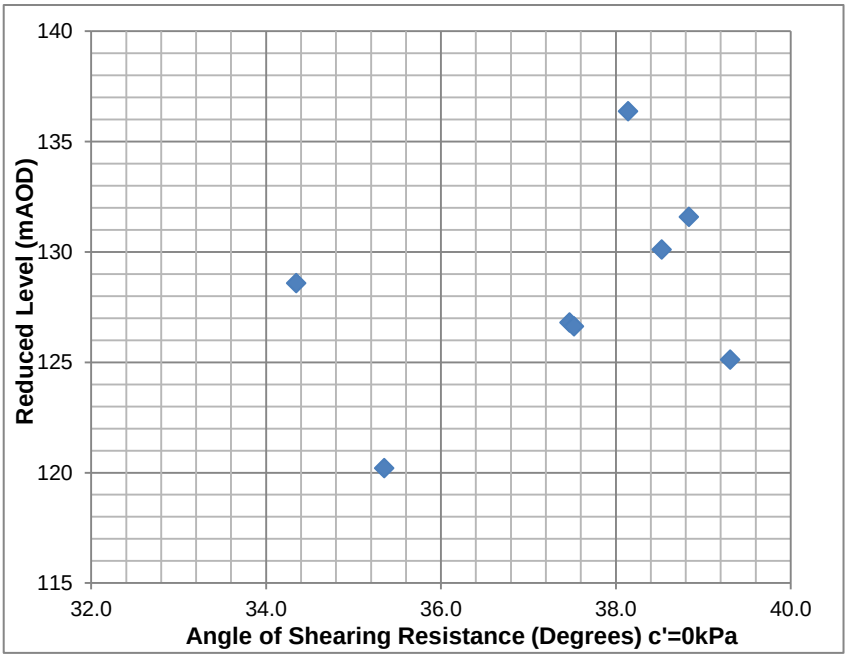

Figure 3 - Effective Internal Angle of Friction according to Triaxial Tests

Derivation of Characteristic Parameters

A statistical analysis has subsequently been undertaken on the effective internal angle of friction data sets derived from the SPT and Triaxial Test results discussed above, in order to calculate an appropriate characteristic value.

The following sources were used to inform the methodology of the analysis.

- Designers Guide to EN 1997-1, Eurocode 7, Geotechnical Design, General Rules
- Bond & Harris, Decoding Eurocode 7

The results of the statistical analysis indicate that a characteristic value of 35° for the effective internal angle of friction is suitable, based upon the 2014 and historic SPT results, and the effective stress testing undertaken in the 2014 site investigation. This is corroborated by the results of the literature review.

Conclusion

An effective internal angle of friction of 35° has been specified for the material based upon the *in situ* and laboratory test results, and is also corroborated by the literature review.

An effective cohesion of 0kPa has been selected for the material based upon the literature review, as an appropriately conservative value given the granular nature of the Upper Greensand and with an awareness that any apparent cohesion of the slopes cannot be relied upon on a long term basis.

Based on the results of the back analysis, it is evident that the cutting slopes do not have a FoS greater than or equal to 1 when applying the parameters specified above. It can therefore be concluded that remedial measures are required to maintain the stability of the cuttings according to current standards.